ANSWERS: Explaining Endothermic and Exothermic Reactions

1) Answers available in April 2015

2 a) Endothermic
Gets colder, the process is endothermic since the enthalpy change ($\Delta_r H°$) is positive, which indicates that energy is absorbed by the system as the ammonium nitrate dissolves. Since heat energy is absorbed by the system from the surroundings (water & beaker), the **water or beaker** will get cooler as they lose heat energy.

b) i) Exothermic
The reaction is exothermic because the enthalpy change ($\Delta_r H°$) is negative; indicating that heat energy is produced during the reaction.
ii) 9800 kJ / 2820 kJ mol^{-1} = 3.48 mol

c) Endothermic.
Heat energy is needed to change the butane from a liquid to a gas; the energy is used to break the weak intermolecular forces between the butane molecules.

3) a) Bonds broken: C–H and O=O
Bonds formed: C=O and O–H
b) The reaction is endothermic, as ΔH is positive and because the water is absorbing energy from the flame.
During this reaction the weak intermolecular forces between water molecules are broken
Energy is needed to break these attractive forces so the reaction is endothermic.

4) a) Endothermic because energy is absorbed to break the attractive forces between the molecules in the solid state.
b) Bonds broken between H-H and between O-O
Bonds formed between H-O
Bond breaking is endothermic as energy is required to separate the atoms in a bond.
Bond forming is exothermic as energy is released as bonds form.

5) Diagram One – exothermic and forward
Diagram Two – endothermic and reverse
Enthalpies of reaction and activation energies correctly labelled.
(Need to explain both equal and opposite i.e. gains instead of releases energy.)

$\Delta_r H$ = + 950 kJ mol^{-1}

Because the same amount of energy is being gained / absorbed / taken in (it is an endothermic reaction) so the $\Delta_r H$ is positive.
Diagram redrawn showing the reactants and products having a higher energy, $\Delta_r H$ remains the same, with a smaller E_a.

Explanation:
The energy of the reactants and products is higher because with increased temperature the particles have more (kinetic) energy.
The activation energy gap is reduced because the particles have more energy to start with so require less energy for effective / successful collisions.
The $\Delta_r H$ will remain the same, this is still the same reaction so regardless of what temperature / how much energy the reactants start with the same amount of energy is released.

(Could acknowledge that the $\Delta_r H$ changes when temperature changes but don't know how it changes.)

n(CaO) = 287 / 82.0 = 3.50
m(CaO) = 3.50 × 56.0 = 196 g